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The effect of video feedback delay on frustration and emotion communication accuracy

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ABSTRACT

Previous research has demonstrated that for unacquainted dyads and groups interacting over video, feedback delay can interfere with the impression-formation process and increase cognitive load, in turn leading to incorrect interpersonal judgments. In this study, 35 dyads participated in two 10-min conversation periods over video monitors. In one period there was a 1-s delay in the audio/video signal and in the other there was no delay. In period 1 the presence of feedback delay was associated with decreased frustration and increased ability to accurately judge a partner's emotions. In period 2, however, feedback delay was associated with increased frustration and had no effect on emotion communication accuracy, which was decreased in both conditions by inaccurate assumed similarity. Results supported and expanded the relation-alignment perspective, which states that individuals will consciously attempt to manage their impressions over technological channels, but that they can also be unconsciously influenced by technological distortion.

1. Introduction

Video communication offers some distinct advantages to people who want to communicate across great distances, especially when the communication takes place between more than two people. The paucity of nonverbal cues available in phone conferencing makes it extremely hard to establish turn taking, to give feedback, and even to know who is speaking. For this reason video communication continues to be of interest to professionals in business, education, and medicine. There are, however, some potential cognitive and interpersonal risks to using video communication. For unacquainted dyads and groups interacting over video, this communication medium can interfere with the impression-formation process and increase cognitive load, leading to incorrect interpersonal judgments (Hinds, 1999).

The quality of video communication is greatly influenced by the capacity of the telecommunication channel. In the early days of the technology, developers made a tradeoff: they felt that it was more important to have a clear image of the other speaker than to have accurate temporal resolution (Bruce, 1996). And so, in many cases, when bandwidth is limited, there is a delay in the audio-visual feedback. The delay may be so small that it is not consciously perceived, or it can be quite obvious and frustrating, as often happens on an international phone call. Bandwidth aside, for many years the refresh rate on cathode-ray monitors was not as fast as the speakers' movements. Current technology has advanced enormously, but as use increases, engineers are still faced with how to compensate for delays in both the equipment and the networks used to carry the signal (Korhonen, 2003).

Studies comparing the effects of reduced image quality, resolution, and feedback delay on video communication accuracy have found that feedback delay is by far the most damaging to interaction (Bruce, 1996; Ehrlich, Schiano, & Sheridan, 2000). One study found that transmission delay was associated with a decrease in performance on a collaborative task, and delay was correlated with a significant increase in levels of interrupted speech (OMalley, Langton, Anderson, Doherty-Sneddon, & Bruce, 1996). Studies looking at the amount of feedback delay needed to disrupt conversation have found that delays of only 150 ms can have an effect on voice communication (Korhonen, 2003). Condon and Ogston (1971) came to the same conclusion decades before, when their studies of face-to-face interaction found that humans are sensitive to subtleties in meaning of delayed movement to the subsecond level.

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2. Relation-alignment perspective

The relation-alignment perspective (Parkinson, 2008; Parkinson, Fischer, & Manstead, 2005) provides a theoretical framework from which we can consider the interpersonal costs of feedback delay in video communication. This perspective begins with the premise that emotions are experienced relationally and, because of this, they require correct feedback from the interaction partner. Feedback may occur at the level of conscious awareness or it may be "prereflective," or, occurs without conscious awareness (Parkinson, 2008).

2.1. Intentional communication

The relation-alignment perspective emphasizes that when people attempt to communicate through constrained channels (say, the telephone or internet), they will explicitly reframe the interaction to achieve the same goals they would pursue in face-to-face interactions. In this case the communication is *articulated*, rather than prereflective: there is some conscious intention to make up for the shortcomings of the medium. This ability to adapt to the communication channel grows more sophisticated over the course of human development. For example, older children performing a "map task" over the telephone compensate for a lack of visual cues by guiding each other through increasingly specific directions, while younger children are unable to do this (Bruce, 1996: Doherty-Sneddon & Kent, 1996). Similarly, OMalley and colleagues (1996) found that adults trying to accomplish a task over a constrained channel were likely to increase both verbal and nonverbal cues to get their point across.

Some communication theories developed for addressing interpersonal adaptation to technological constraints emphasize the flexibility that a "cues filtered out" medium provides (Short, 1976). For example, Walther's social information processing theory (SIP; 1992) assumes that people adapt their self-presentation in mediated environments. When a medium is consciously perceived as different, people will change their behavior accordingly. However, users may not always be consciously aware of technological distortions. In the case of video communication, the amount of delay may or may not be noticeable at a conscious level.

2.2. Mutual influence

The relational-alignment perspective recognizes the mutual influence that interaction partners have on each other, and that this unfolds against a backdrop of similar or divergent goals. Both partners adjust to take into account the actions and reactions of the other person, which may result in increased similarity or increased divergence. Partners are influenced by both articulated and prereflective aspects of each others' behavior, but these may become confounded, so that a cue that is sent unintentionally is perceived as deliberate or vice versa. Further, given that the establishment of rhythm in interpersonal exchange often takes place outside the realm of conscious awareness, it is unlikely that people would be able to effectively compensate for a disruption they do not realize is there.

The emotional content of the interaction over constrained channels is subject to several influences. For one, temporal delay can be frustrating, especially to the new user. This frustration will influence the emotional presentation of one user to the other in a way that would not be present in face-to-face contact (Parkinson, 2008). Previous studies have not directly measured the level of frustration experienced in delay versus non-delay conditions. Parkinson and Lea (2011) tested their theory using video communication about liked and disliked celebrities. Dyads conversed in two 5-min conversations where there was either a "normal transmission delay" or a "minimal transmission delay." Agreement was manipulated by having the participants rate celebrities ahead of time; the experimenter then selected one celebrity that was equally disliked by both and one that was disliked by one and not the other. Participants rated the medium more negatively in the high delay condition, and had more difficulty communicating, even though they did not attribute this to a transmission lag. There was a heightened awareness of lack of eye contact in the lag condition, and they had a particularly hard time when they did not agree with each other. The authors concluded, "lacking immediate interpersonal feedback seems to result in greater disengagement from interaction when you do not share the other's opinion about a topic," (Parkinson, & Lea, 2011, p. 15). In other words, when participants were less similar in their views, they had an increased need to accurately track the nonverbal cues of their partners.

Additionally, the temporal dynamics of the medium influence the emotional unfolding of the interaction. If there is a delay, then "to the extent that emotions are attuned to others' responses, the absence of immediate feedback is likely to affect the way they unfold over time." (Parkinson, 2008, p. 1517). Interaction is based on turn-taking. Attunement takes places over the course of an interaction as partners increase in accuracy of sending and receiving emotion-related cues. To the extent that one person's articulated action is not perceived as articulated, or their prereflective response is perceived as articulated—or any other combination of misunderstandings—the next turn in the interaction will adjust to this incorrect perception and so will the next one in turn, and so on, resulting in decreased interpersonal attunement. For example, in video delay this may occur in the form of awkward pauses that may unintentionally signal a lack of attentiveness. Conversely, depending on the facial expression accompanying the extended gaze, the awkward pause may also make a partner appear more thoughtful than they actually are. In either case, this can influence the willingness of the interaction partner to keep talking. So, in summary, problems with temporal resolution affect both the level of frustration and the level of communication accuracy in mediated interactions, and this would be expected to worsen across the course of the interaction.

The reviewed research demonstrates the challenge that video delay poses to the unfolding of interpersonal interactions. The process of responding to a partner relies, at least in part, on the accurate perception of emotion cues at both the prereflective and articulated levels. The current research used politically charged topics to generate strong emotions, and then asked specific questions about emotional experience and empathic accuracy. The topics themselves were frustrating, so interactions were compared at two points in time in order to untangle responses to the topics and responses to the temporal delay.

3. Extension of the relation-alignment perspective: assumed similarity and emotion communication accuracy

Accuracy in the perception of a partner's emotions in face-to-face situations is the result of several interlocking processes. In initial interactions, it is strongly related to assumed similarity, and is likely to lead to actual similarity as partners converge in meaning throughout the course of their interaction (Kenny & Acitelli, 2001). Through coordination and mimicry of speech, movement, and expression, individuals are able to understand, and perhaps share, similar social experiences. Synchronous nonverbal communication should lead to enhanced emotion communication accuracy. In this sense, accuracy during interaction is not simply a raw perception that implies a good guess based on knowledge of the partner, it is fundamentally intertwined with actual similarity

and assumed similarity between partners. Cronbach pointed out this associated measurement problem in 1955 and, since then, statistical techniques have been developed to parse out these highly correlated concepts (Cronbach, 1955; Kenny, 1994). *Assumed similarity* is the degree to which one sees others as similar to oneself. *Emotion communication accuracy* is the degree to which one is able to accurately predict how their partner feels, with the partner's self report as the objective criterion. While Parkinson's and Lea's (2011) previous research measured interpersonal attunement, it did not parse out the effect of assumed similarity from genuine emotion communication accuracy.

Uncertainty Reduction Theory suggests that similarity and reciprocity are important predictors of outcomes of initial interactions (Berger & Calabrese, 1975). Thus, while people are naturally drawn to others with similar attitudes, they also enter new interactions with the hope of *establishing* similarity with others as a way of creating "stable, predictable, and controllable communicative environments" (Sunnafrank, 1986, p.159). And this will persist even when the conversation partner is revealed to be attitudinally similar or dissimilar during preacquaintance (Sunnafrank, 1986). The projection of similarity is also enhanced by the expectation of future interaction with the conversation partner, such as when they are told they will be discussing a controversial topic (Miller & Marks, 1982). Assumed similarity is, at least in some cases, actually a better predictor of friendship intensity during acquaintanceship than actual similarity (Selfhout, Denissen, Branje, & Meeus, 2009). The same research found that expectations drive communicative behavior, which then affect friendship formation. Therefore if the goal in an initial interaction is to be friendly, this should persist even in the face of temporal delays in video communication. Whether the delay is perceived or not, participants should be motivated to assume similarity and make the best of the interaction.

3.1. Summary

In summary, we can generally expect the effect of video delay to take place against a backdrop of good will and effort to communicate accurately and establish similarity. However, delays are inherently frustrating and can make it more difficult to coordinate one's own perspectives with those of a partner. In the present experiment, unacquainted individuals were asked to have two 10-min conversations over a video monitor system. During one 10-min period there was a one-second delay in the transmission signal. During the other 10-min period, there was no delay in the signal. The dyads were randomly assigned to receive the control or delay condition first and the other condition second. Given that temporal coordination is a key element in the interpretation of emotions, that a small disruption in coordination can cause frustration and change the interpretation of nonverbal cues, and that this process should unfold over time, we hypothesized that a feedback delay in the video and audio signal of the communication system should result in a change in the emotional experience and the emotion communication accuracy of the interactions, especially in the second interaction period, when participants had already had a chance to become briefly acquainted.

RQ1: Does feedback delay increase self-reported frustration in period 1?
H1: Feedback delay will increase self-reported frustration in period 2.
RQ2: Does feedback delay affect assumed similarity in periods 1 or 2?
RQ3: Does feedback delay affect emotion communication accuracy for frustration in period 1?
H2: Feedback delay will decrease emotion communication accuracy for frustration in period 2.

4. Methodology

The main hypotheses of the study were tested using a 2×2 design, with order of conditions and presence or absence of delay as between-dyads factors, and with separate analyses for self-reported frustration, assumed similarity, and emotion communication accuracy as dependent variables. Participants interacted with their partners through video monitors in both the control condition, where no delay was present, and in the delay condition, where a delay was introduced in their signal. A different topic was discussed during each interaction, but the topics were similar on their relationship to political ideology and ability to elicit emotions. An additional two factors were incorporated in the design to allow us to test for order effects due to the order of topics and the order in which the participants filled the "self" and "other" emotion questionnaires following each period. Results were analyzed separately for the first and second conversation periods.

4.1. Participants and experimental design

A total of 70 participants were recruited from introductory communication courses from a large northeastern public American university and took part in the experiment for extra class credit. The randomly assigned dyads consisted of 5 male–male, 13 male–female, and 17 female–female combinations. The mean age was 19.14 (sd = 1.96).

4.1.1. Audio-visual communication setup

Participants interacted through a video monitor system. Two rooms were equipped with video cameras and large TVs. The signal from each camera ran through a delay unit to the other room's TV. The cameras were setup on top of the TV to allow the participants to see each other while looking at the screen. While all effort was made reduce parallax effect, participants did not have the sense of perfect gaze contact. In the open questions asked about the experiment, a few participants commented about this effect. Any parallax effect is controlled for since the setup is fixed and consistent. However, because gaze is an important conveyor of nonverbal information, it is still possible that the camera setup could have influenced the communication between the participants in a homogeneous way (see Fig. 1).

4.1.2. Topics

Participants were asked to discuss 2 politically charged topics, the 2004 United States presidential election and the United States involvement in the war in Iraq (the experiment took place in the Fall of 2004, shortly before the presidential election). Participants were given a topic sheet with the topic title and a list of 6–7

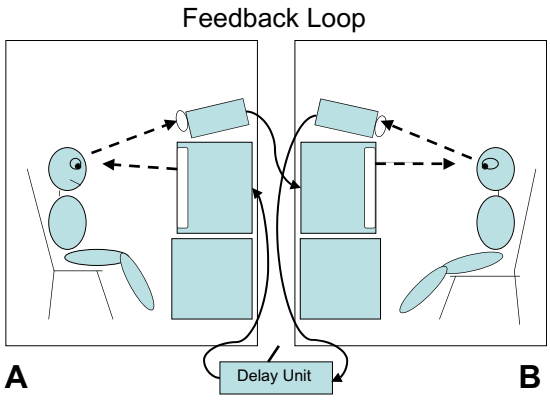

Fig. 1. Configuration of video communication equipment.

questions and items to guide the discussion. The topics were chosen so that they would induce politically and emotionally charged discussion for the whole interaction period (10 min). Questions for the presidential election topic included "How do you feel about the particular candidates?" "How do these feelings differ from those of your friends and family?" "What would you say to someone who disagrees with your opinions?" Questions for the war in Iraq topic included "What do you feel should be done now?" "What is your opinion of news media coverage of the war?" "What unanswered questions do you have?".

4.1.3. Delay manipulation

The delay was manipulated through the delay unit (a commercially-available DV recorder) and a bypass switch. The delay was created by setting up the delay unit to pause for one second before playing back the incoming audio/video stream to the partner. For the non-delay (control) condition, the entire delay unit was bypassed with a switch. Each dyad interacted with no delay and with a one-second delay.

4.1.4. Procedures

Participants came to the designated lab and reviewed and signed the informed consent document approved by the Institutional Review Board. Participants filled out a pre-task questionnaire while waiting. They were then outfitted with heart rate sensors for a data set that is not reported on here. Participants were given clip boards with all of the task-related questionnaires in the order they were to be answered. In between questionnaires there was a sheet of paper with a large STOP sign indicating when to wait for the next conversation period. Participants were seated in separate rooms in chairs that were a standard distance from the TV/video camera setup. Participants wore headphones and microphones. Their speech and video data were recorded for data sets that are not reported on here. Instructions were presented via powerpoint slides on the participant video screens. The screen was then switched to a video feed of their partner. An audio tone indicated when to begin and end the conversation periods. After each conversation period the screen was returned to the instruction slides and participants had unlimited time to fill out the appropriate questionnaires. They were instructed to look at the screen when they had completed the questionnaires. When both participants had completed the first questionnaires for the first period they were switched back to the video feed of the partner and an audio tone signaled when to begin and end the next period. After both conversation periods were over participants filled out a post-task questionnaire that included questions about the perceived delay. They were then debriefed and thanked for their time.

4.2. Measures

4.2.1. Previous acquaintance

Acquaintance was measured with two items rated on a 7-point Likert-type scale, ranging from "strongly disagree" to "disagree." These items were "This person is a very good friend of mine." and "In know this person very well." Alpha reliability for the two-item measure was .98.

4.2.2. Delay perception

Perception of the delay was measured with four items asking about the performance of the video system during the second interaction, rated on a 7-point Likert-type scale, ranging from "strongly disagree" to "strongly agree." (Rauh & Renfro, 2004). These items were "The video system was responsive to my actions," "There was no delay in the video system," "The interaction was not disturbed by the video system," and "The video system was not synchronized," (reversed). This last item was dropped because it loaded poorly. The resulting reliability was alpha = .75. To avoid sensitizing the participants to the delay, perceived delay was only measured after both interactions were completed. In addition, we explicitly asked participants to make their ratings based on their second interaction. Since the conditions were balanced, this allowed for comparison of delay perception between conditions.

4.2.3. Frustration

The Interpersonal Emotions Scale (IES), is composed of a set of 26 emotion words selected to represent individualistic and social factors (Buck, Renfro, & Rauh, 2003). After each 10-min conversation period, participants were instructed to either "Please indicate YOUR FEELINGS while carrying out the task you just finished," for "self" reports, or "Please indicate your PARTNER'S FEELINGS while carrying out the task you just finished," for "other" reports. Then a list of emotion words was presented, each on a 7-point Likert-type scale ranging from "Not at all" to "Very much". These were not meant to be comprehensive, but rather to represent the range of emotions one might feel in an informal and interactive social situation. The ordering of self and other reports was balanced by dyad. From these emotion words, a subscale of frustration was created by selecting the item for frustration and the four items that correlated most strongly with frustration, as well as were moderately correlated with each other. The inter-item correlations ranged from $r = .50$ to $r = .81$. The items were "frustrated," "anxious," irritated," and "cautious." Conceptually, these all seemed to indicate a kind of generalized arousal. While the item "cautious" may not at face value appear to be covariant with frustration, it is reasonable within the experimental context, which required participants to discuss political topics that were both emotionally loaded as well as divided along partisan lines. Therefore someone who had strong feelings about the war or presidential election may have also felt cautious about discussing their feelings with a stranger who would potentially strongly disagree. The reliability was $\alpha = .84$ for the self report measure and $\alpha = .76$ for the measure rating the partner's emotions.

4.2.4. Assumed similarity and emotion communication accuracy

The self and other reports of frustration were used in combination to measure assumed similarity and emotion communication accuracy. *Assumed similarity* is the degree to which one sees others as similar to oneself. This was operationalized by regressing the self report of Partner A onto the other report of Partner A. *Emotion communication accuracy* is the degree to which one is able to accurately predict how their partner reported feeling. As described above, a large portion of this variance is shared with assumed similarity. Therefore, following the precedent set in previous research (Neyer, Banse, & Asendorpf, 1999; Pearson et al., 2008), we report a measure of "direct communication accuracy," which measures the effect of regressing the self report of Partner B onto the other report of Partner A, while controlling for the self report of Partner A (assumed similarity). This is more conservative estimate that provides some information about how much insight a partner might have that is completely different from their own emotional experience. The less conservative measure of accuracy is reported as "total accuracy." This was operationalized by regressing Partner B's self report of frustration onto Partner A's other report of frustration without controlling for assumed similarity.

5. Results

5.1. Data analysis

A dyadic effect was expected for these variables. That is to say, people in the same dyad share an experience, and this may account for some shared variance in their reporting. Failing to account for nonindependence of dyadic data can lead to inaccurate estimates

of standard errors, which can lead to both Types I and II errors (Griffin & Gonzalez, 1995; Kenny, Kashy, & Bolger, 1998), improper effect sizes, and incorrect degrees of freedom. The data set was organized as a pair-wise structure (Griffin & Gonzalez, 1995). Analyses were conducted using the linear mixed models module in SPSS to examine the effect of the delay condition while controlling for the effect of the dyad (Kenny, 2005). The covariance of dyad members was included as a random effect in the model, providing a measure of nonindependence of cases within the dyad. Kenny et al. (1998) argued that 36 dyads are needed to have an adequate power to test for nonindependence that biases the independent variable, and that if there are fewer groups, group should be used as the unit of analysis. This results in relatively little loss in power, and provides a more unbiased estimate of the significance values.

5.2. Contextual variables

5.2.1. Previous acquaintance

Four dyads were previously acquainted before the experiment, and, of these, only two dyads indicated that they knew each other well. Previous acquaintance was included as a predictor in initial models, but it had no significant effects and was removed.

5.2.2. Frustration order effect

Paired samples *t*-tests showed that people were significantly more frustrated in the first period than the second period, $t(69) = 4.66$, $p < .00$, not taking the experimental condition into account. They also perceived their partners to be more frustrated in the first period, $t(69) = 2.95$, $p = .004$. All variable means are reported in Table 1. Therefore some frustration was likely due to the situation of getting to know a conversation partner through a potentially arousing political topic, rather than the delay manipulation, which acted as a moderator of this underlying frustration, as shown below.

5.2.3. Order of topic

A set of independent samples *t*-tests comparing conversation topic in the first period confirmed that levels of frustration in both self and perception of other reports were not significantly different by topic. (See means in Table 1.)

5.2.4. Order of self and other reports

There was an unintended order effect for if the participant was asked to report on his or her own emotions first, or those of the partner. When asked to report on their own emotions first, independent samples *t*-tests showed that participants in period 1 rated themselves more frustrated than those who reported on their partner's emotions first, $t(68) = -2.39$, $p = .02$ (other report first was coded as −1; self-report first was coded as 1). While the small sample size makes it more possible that this effect is due to Type I error, it could also be that being forced to think about the partner's emotions first led the participant to judge the interaction less critically than if they were instructed to consider their own emotions immediately after the conversation. This unexpected effect was not included in the subsequent analyses but we will return to it in the discussion. There was no significant difference between these two groups in the second conversation period.

Table 1
Self and other reports of frustration.

Variable	Period 1 mean (*sd*)	Period 2 mean (*sd*)
Within subjects		
Self-reported frustration	2.50 (1.19)	2.06 (1.20)
Perception of other's frustration	2.32 (1.00)	2.07 (1.14)
Between subjects		
Self-reported frustration, presidential election	2.44 (1.18)	2.15 (1.21)
Self-reported frustration, war in Iraq	2.56 (1.22)	1.97 (1.19)
Self-reported frustration, self-report first	2.80 (1.19)	2.15 (1.13)
Self-reported frustration, other report first	2.14 (1.11)	1.95 (1.28)
Self-reported frustration, delay condition	2.11 (1.10)	2.46 (1.30)
Self-reported frustration, control condition	2.87 (1.17)	1.64 (.93)

5.2.5. Delay perception

Delay perception was measured in reference to the second period only. Those who experienced the delay condition second ($m = 4.56$, $sd = 1.73$) were compared with those who experienced the non-delay condition second ($m = 3.90$, $sd = 1.87$). These two groups were not significantly different ($t(67) = 1.52$, $p = .13$), however the frequency distribution of the means showed that the mode response for those who experienced the delay second was $m = 5.33$ (25% of the group) and for those who experienced no delay in the second period it was $m = 2.00$ (21% of the group). Therefore some people were more aware of the delay than others, although there was no significant correlation between partners on the amount of delay perceived in the second period, $r = -.12$, $p = .51$. Perceived delay was tested as a predictor of self-reported frustration and had no significant interaction with delay condition.

5.3. Effect of delay on self-reported frustration

5.3.1. Period 1

RQ1 asked if participants in the delay condition would report more frustration than participants in the control condition in period 1. To address this, a linear mixed model was created to measure the effect estimate at the level of the dyad, with dyad members as a repeated random factor. The experimental condition for that period (control or delay) was the fixed factor, and the outcome variable was self-reported frustration. Overall, there was a main effect for condition, where the control condition was associated with *higher* frustration, $t(33) = -2.90$, $p = .007$, $d = -1.01$. (See Table 1 for means and standard deviations.) There are two possible explanations for this. Given the overall levels of frustration in the first period, it is possible that the delay condition served to diffuse some tension by requiring partners to allocate some cognitive resources to tracking the exchange rather than focusing solely on the topic. A second possibility is that the delay made their partner appear more attentive, creating a more comfortable environment in which to talk about a difficult topic with a stranger.

5.3.2. Period 2

The same pattern did not hold in the second period of conversation. Supporting H1, frustration was more strongly predicted by the delay condition than the control condition, $t(33) = 3.20$, $p = .003$, $d = 1.11$. Therefore partners who had a chance to get acquainted in the first period (with no delay) were more affected by the feedback delay in the second period.

5.4. Effect of delay on assumed similarity and emotion communication accuracy

5.4.1. Period 1

RQ2 and RQ3 asked if the delay condition would affect assumed similarity and emotion communication accuracy for frustration in period 1. Overall, assumed similarity was a strong predictor of

how the partner was perceived, $t(31) = 3.05$, $p = .005$, $d = 1.10$, but even controlling for this there was a trend toward some direct accuracy in the perception of the other, $t(31) = 2.00$, $p = .055$, $d = .72$. Unstandardized effect estimates are shown in Table 2. This finding indicated that in both conditions there was some understanding of the partner's feelings above and beyond simply ascribing one's own feelings to them. Neither assumed similarity nor direct accuracy significantly interacted with the delay condition. When assumed similarity was removed from the model, there was a significant interaction between the delay condition and total accuracy, $t(39) = -2.85$, $p = .007$, $d = -.91$. The estimate was negative, meaning that the delay condition (coded as −1) was associated with increased accuracy for predicting the partner's frustration.

5.4.2. Period 2

The same analysis was performed for period 2. Overall, assumed similarity was again a strong predictor of how partners rated each other, $t(33) = 3.31$, $p = .002$, when not taking into account the effect of the delay. However, this time there was no evidence of any direct accuracy, $t(33) = .10$, $p = .92$, $d = .03$. With assumed similarity removed from the model, there was a significant negative relationship between Partner B's self report of frustration and Partner A's rating of Partner B's frustration, $t(33) = -5.68$, $p < .001$. This indicates that the more partners assumed similarity, the more they were incorrect in their judgments of others. H2 was not supported:none of the variables were significantly influenced by the delay condition, even when assumed similarity was removed from the model.

6. Discussion

These results extend the relation-alignment perspective in several useful ways. First, we used a direct measure of emotions to test the hypotheses that feedback delay would interfere with both emotional experience and emotion communication. We also accounted for the effect of the dyadic interaction on the experience of emotions. Additionally, we observed the order effect of experiencing the delay when initially getting acquainted versus experiencing it when acquaintance had already been established. In doing this, we tested the assumption implicit in the theory that people would make an articulated effort to override the effect of the delay in their initial interactions.

Frustration was, in general, higher in the first period of conversation, and higher when one reported one's own emotions before those perceived in the partner. These findings, while not explicitly a part of the main hypotheses, were also valuable. Clearly the delay condition was not the only source of frustration, as it would not be in real life. The political topics were selected because they tended to evoke strong negative emotions, including frustration. And the act of being in an experiment and being asked to discuss these topics with a stranger perhaps was also frustrating. Being forced to consider the partner's feelings first was associated with less frustration, however. This finding could be useful in more applied situations, where one might imagine instructing those who frequently communicate via video link to consciously attend to their partner's emotional state as a way to reduce frustration and increase attunement. Our measure of frustration was not specific to any particular aspect of the interaction. Self-reported frustration was quite low, however a more specific measure could reveal increased sensitivity to specific contextual aspects of the experiment. Future efforts will attempt to parse frustration regarding the topic, the partner, and the medium.

There was a main effect of the delay condition on frustration, but the direction was different in each period. For people just meeting each other in the first period, frustration was higher when there was no delay. This suggests that the delay forced conversation partners to make more effort to follow each other, rather than allocate cognitive resources to attending to their feelings about the topic or the situation. It may have also slowed the interaction down through the introduction of longer pauses between turns, allowing them to be more careful in their initial interaction. In the second period the delay had the hypothesized effect: it increased frustration. Notably, those who experienced the delay second had already had a chance to get acquainted under non-delay conditions in the first period. Therefore the effects of feedback delay may be more damaging when it is inconsistent, or when it occurs after people have established an initial acquaintance.

The findings on emotion communication accuracy illustrate the role of how assumed similarity can hinder accuracy when feedback delay is present, even though in face-to-face interaction it may actually facilitate accuracy (Kenny & Acitelli, 2001). In the first period, when partners were initially getting acquainted and most likely had the goal of establishing rapport and similarity, total accuracy was positively affected by the delay condition. This effect points to a pattern where being forced to slow down actually decreased frustration and increased accuracy. In the second period, however, partners assumed similarity in roughly the same pattern-but this pattern was associated with inaccuracy and was not affected by the delay condition. In this case, being forced to slow down had no benefit but also did not appear to hinder the interaction.

To extend these findings, it will be important to take these potential interactions into account when assessing video communication in the future. Consideration of when topics are affectively loaded, or when the people interacting have never worked together offline, or when they are relatively inexperienced with the technology, is important. Our results run somewhat counter to other studies, which find that acquaintance has been found to improve empathic accuracy (Stinson & Ickes, 1992) as people become more interpersonally attuned. Parkinson and Lea (2011), after a follow up study, concluded that partners who were acquainted before the study were less prone to the communicative limitations of the delay because they were better able to anticipate each others' emotions.

Our study of initially unacquainted individuals, by contrast, found that a small delay had more impact after a brief period of acquaintance. This suggests that the impact of delay is nonlinear, with a potentially vulnerable period between the time when people first meet and are guided by the good-will effort to establish similarity, and the time when they know each other well enough to anticipate each others' emotions without the benefit of close tracking of nonverbal communication. In cases where close tracking of nonverbal cues is important, chat, email, or asynchronous video communication may be more appropriate. This would allow for the strengths of the medium described in social information processing theory (Walther, 1992) to really stand out, as people could retain more control of their self presentation and could generate text-based checks on how a partner was feeling.

Table 2
Assumed similarity and emotion communication accuracy.

Variables	Assumed similarity	Direct accuracy	Total accuracy
Period 1	.99*	.65*	−.19
Period 1 × delay	.21	−.41	−.51*
Period 2	.95*	.03	−.80*
Period 2 × delay	−.32	−.13	.22

Note: All effect estimates reported in the table are unstandardized. The delay condition was coded as −1 and the control (no delay) condition was coded as 1.
* $p < .05$.

Although the data were collected in 2004, the issue of internet transmission delay continues to be of interest and concern (Tabib & Jalali, 2008; Yang & Yang, 2007). Wireless technologies have grown so advanced that it is expected that real-time video communication devices are poised to be the next big trend in mobile communications Sabir, Bovik, & Heath, 2005. This will increase demand and require new technologies. While LCD screens and broadband access have reduced some proximate sources of delay, there are still multiple distal variables due to the distributed network structure of the internet communication. In reality there may never be a time when delay is not of concern, therefore it becomes increasingly valuable to develop theories and best practices for mitigating its effects, not just with technology, but with personal and organizational communication policies as well.

The ideas represented here are a useful consideration in any situation where there is a potential for signal processing delay. One source of the delay is the technology mediating the communication channel. While these delays are constantly being reduced by newer innovations, humans continue to range farther from home. With distance comes more possibility for noise or delay in the signal, and, consequently, the need to realign our interactions in order to meaningfully connect with one another.

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